

What is claimed is:

- 1 1. A method of manufacturing a semiconductor device,
2 comprising the steps of:
3 forming an oxide film on a semiconductor substrate;
4 introducing nitrogen into the oxide film; and
5 thermally oxidizing the oxide film in a gas
6 atmosphere containing oxygen;
7 wherein the temperature during said thermally
8 oxidizing is higher than the temperature of any other
9 processes performed later than said thermally oxidizing.
- 1 2. The method of manufacturing a semiconductor device
2 according to claim 1,
3 wherein the nitrogen comprises activated nitrogen.
- 1 3. The method of manufacturing a semiconductor device
2 according to claim 1,
3 wherein the atmosphere in said thermally oxidizing
4 process contains at least one of O_2 , O_3 , activated oxygen,
5 oxygen radicals and oxygen ions.
- 1 4. The method of manufacturing a semiconductor device
2 according to claim 1,
3 wherein the partial pressure of oxygen is 0.075 to
4 250 Torr in said thermally oxidizing process.

1 5. The method of manufacturing a semiconductor device
2 according to claim 1, further comprising oxy-nitriding
3 process performing a thermal treatment process in an
4 atmosphere contains at least oxygen and nitrogen after said
5 thermally oxidizing process.

1 6. The method of manufacturing a semiconductor device
2 according to claim 5,
3 wherein the thermally oxidizing process is performed
4 in an atmosphere contains at least oxygen and nitrogen.

1 7. The method of manufacturing a semiconductor device
2 according to claim 6,
3 wherein the gas containing oxygen and nitrogen is at
4 least one gas of NO, N₂O, and NO₂.

1 8. The method of manufacturing a semiconductor device
2 according to claim 1,
3 wherein at least a portion of dangling bonds on a
4 surface of the semiconductor substrate that exists at the
5 interface between the semiconductor substrate and the oxide
6 film is terminated by nitrogen.

1 9. The method of manufacturing a semiconductor device
2 according to claim 1,
3 wherein nitrogen is introduced in an interface

4 between the oxide film and the semiconductor substrate at
5 $1\text{E}11$ to $7\text{E}14$ atoms/cm².

1 10. The method of manufacturing a semiconductor device
2 according to claim 1,
3 wherein nitrogen is introduced in an interface
4 between the oxide film and the semiconductor substrate at
5 $7\text{E}12$ atoms/cm².

1 11. The method of manufacturing a semiconductor device
2 according to claim 1,
3 wherein the semiconductor substrate is not exposed to
4 the ambient air during the step of introducing nitrogen and
5 the thermally oxidizing process.

1 12. The method of manufacturing a semiconductor device
2 according to claim 5,
3 wherein the semiconductor substrate is not exposed to
4 the ambient air during the step of introducing nitrogen,
5 the thermally oxidizing process, and the oxy-nitriding
6 process.

1 13. A semiconductor device comprising:
2 a semiconductor substrate; and
3 an oxide film formed on the semiconductor substrate,
4 wherein at least a portion of dangling bonds on a
5 surface of the semiconductor substrate that exist at an

6 interface between the semiconductor substrate and the oxide
7 film is terminated by nitrogen.

1 14. The semiconductor device according to claim 13,
2 further comprising:

3 a gate electrode formed on said oxide film;
4 wherein the concentration of nitrogen within the
5 interface between the gate electrode and the oxide film is
6 higher than the concentration of nitrogen within the oxide
7 film.

1 15. The semiconductor device according to claim 13,
2 wherein the density of the nitrogen that terminates
3 the dangling bonds on the surface of the semiconductor
4 substrate is $1E11$ to $7E14$ atoms/cm².

1 16. The semiconductor device according to claim 14,
2 wherein the density of the nitrogen that terminates
3 the dangling bonds on the surface of the semiconductor
4 substrate is $1E11$ to $7E14$ atoms/cm².

1 17. The semiconductor device according to claim 15,
2 wherein the density of the nitrogen that terminates
3 the dangling bonds on the surface of the semiconductor
4 substrate is $7E12$ atoms/cm².

1 18. The semiconductor device according to claim 16,

- 2 wherein the density of the nitrogen that terminates
- 3 the dangling bonds on the surface of the semiconductor
- 4 substrate is $7E12$ atoms/cm².